

Notes on the Influence of the Estimation Algorithm and Track Spacing on DEM Accuracy

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and

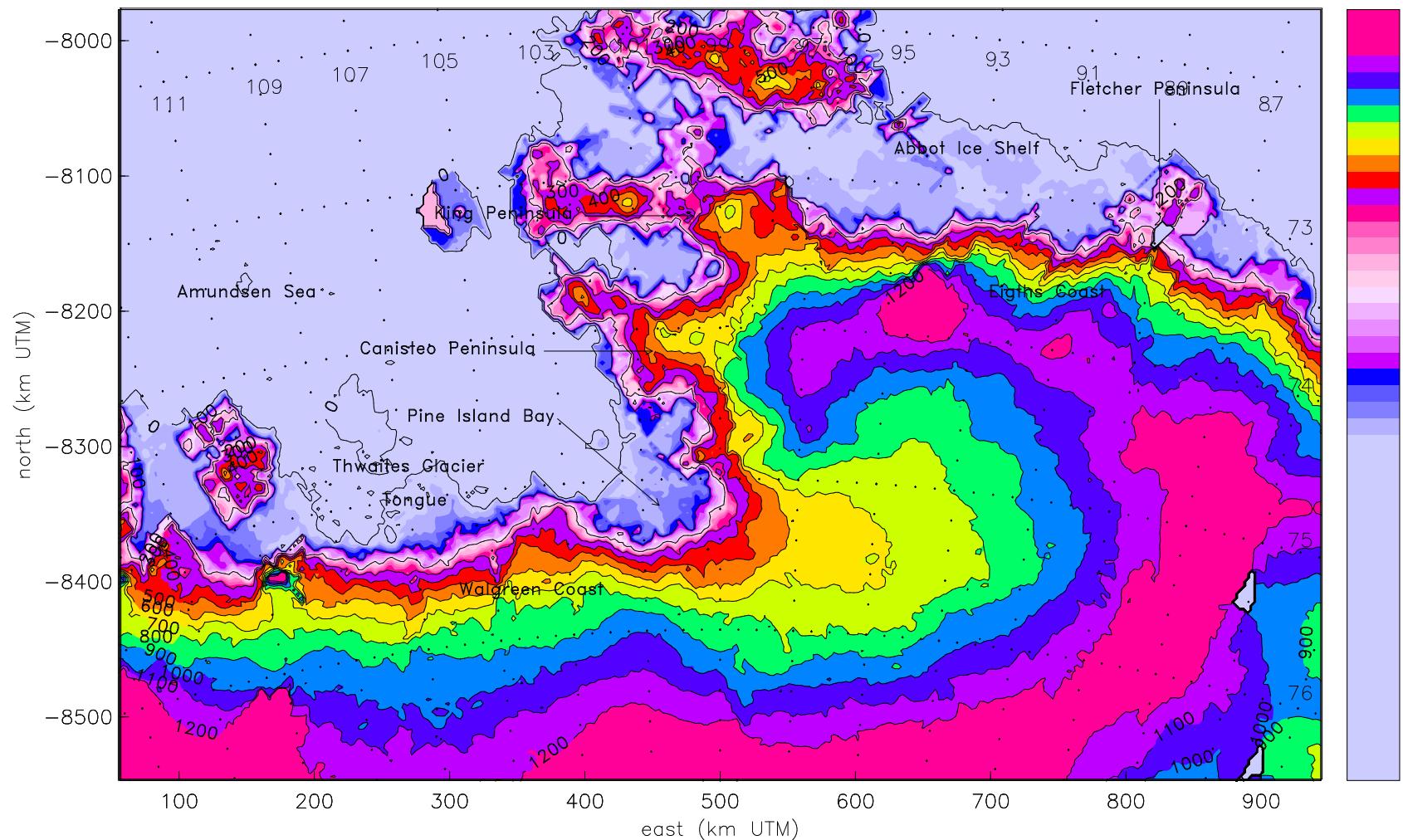
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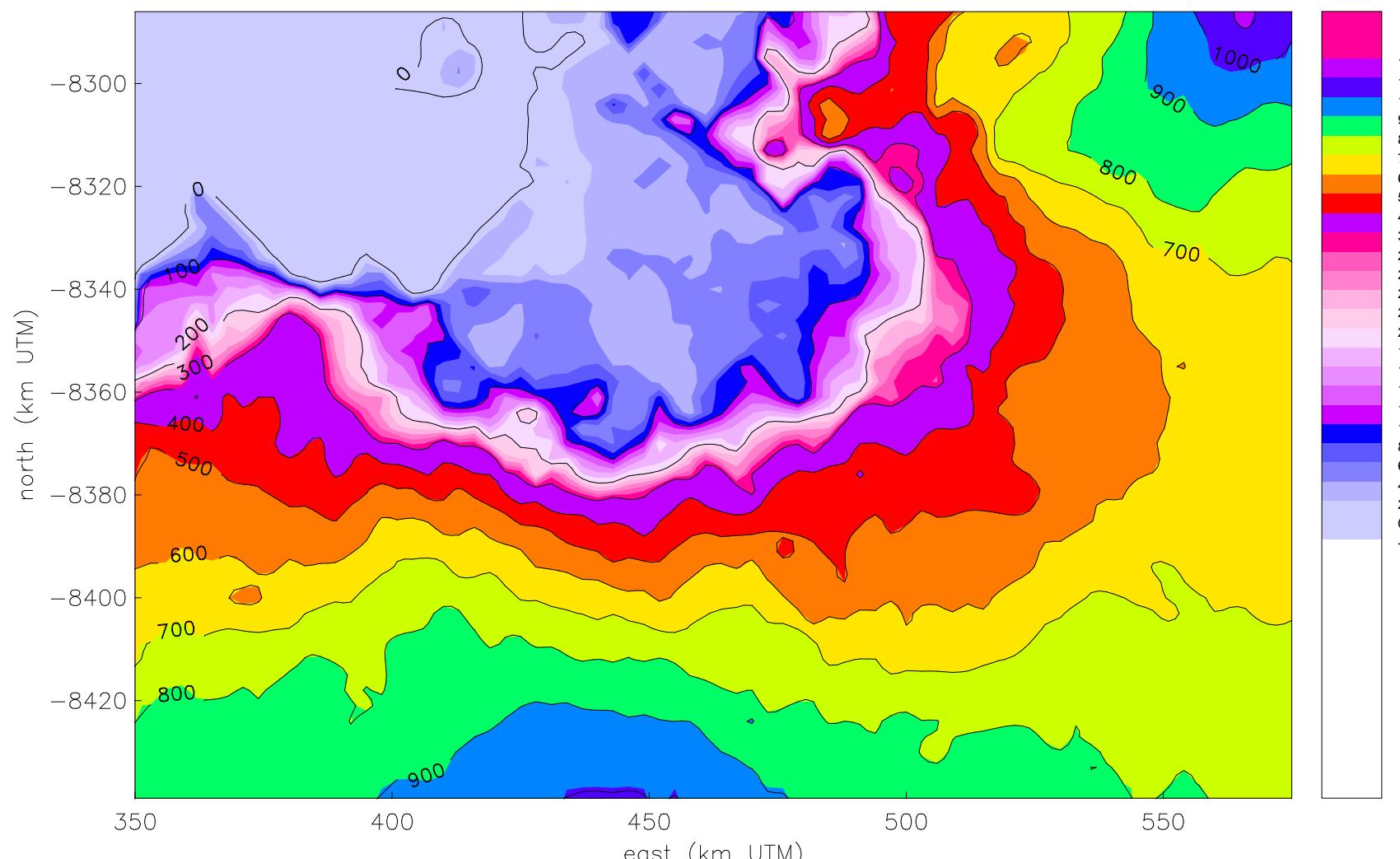
Note 1: Estimation Algorithm and DEM Quality

Walgreen Coast – GLAS Data



GLA06 Data, (Laser 2A, gain-crit, rel18), Oct/Nov 2003, vario(350,3450,6000m), search-rg 30km, 1:5000000,
gla06.1.gain.0.col8

Pine Island Glacier – GLAS Data



GLA06 Data, (Laser 2A, gain-crit, rel18), Oct/Nov 2003, vario(350,3450,6000m), search-rg
30km, 1:2000000, gla06.1.gain.smallpine2.v2.col8

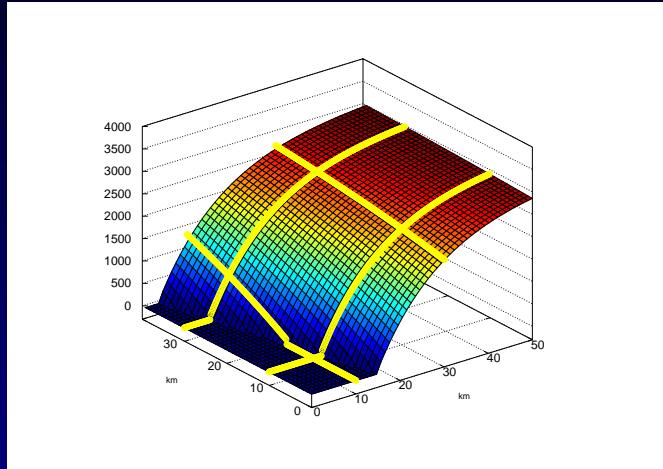
Note 2:

Dependence of
DEM Accuracy on Track Spacing

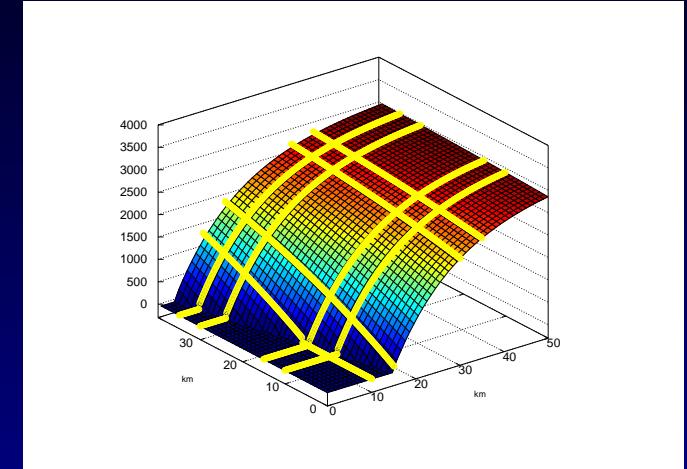
Surface Reconstruction Experiments: Steps

- (1) model an ice surface with non-linear and/or non-differential slope
- (2) select sample orbits
 - (a) 20 km spacing ($\approx 50^\circ$ lat, 91-d repeat cycle)
 - (b) 10 km spacing (70° lat, 91-d; or 50° lat, 183-d repeat)
 - (c) 5 km spacing (70° lat, 183-d repeat)
- (3) reconstruct the surface, using geostatistical interpolation/ extrapolation
 - (a) ordinary kriging
 - (b) advanced kriging methods

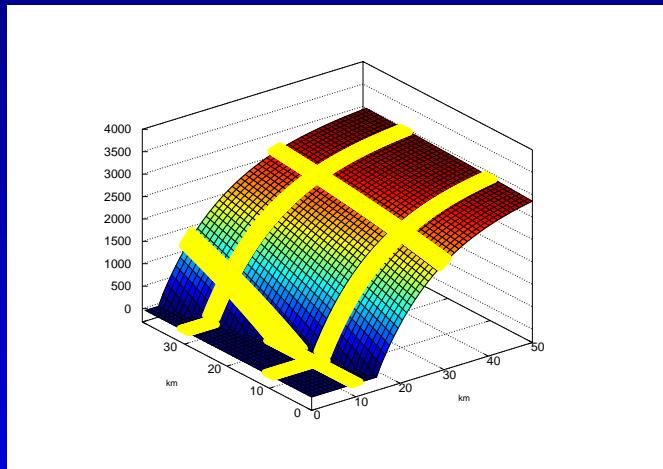
Beam Configurations (20 km orbit spacing)



single beam

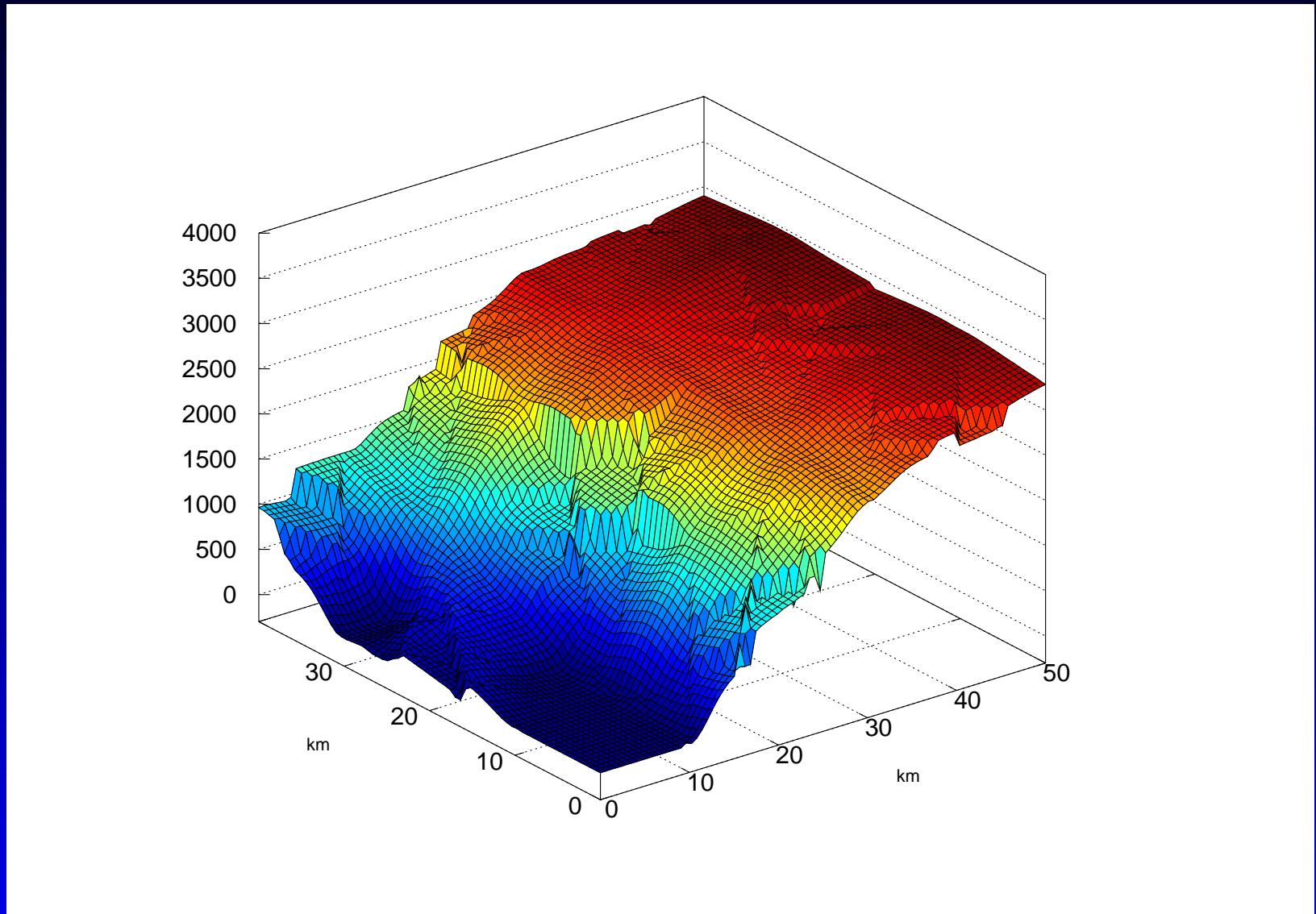


double beam (spaced 5km)



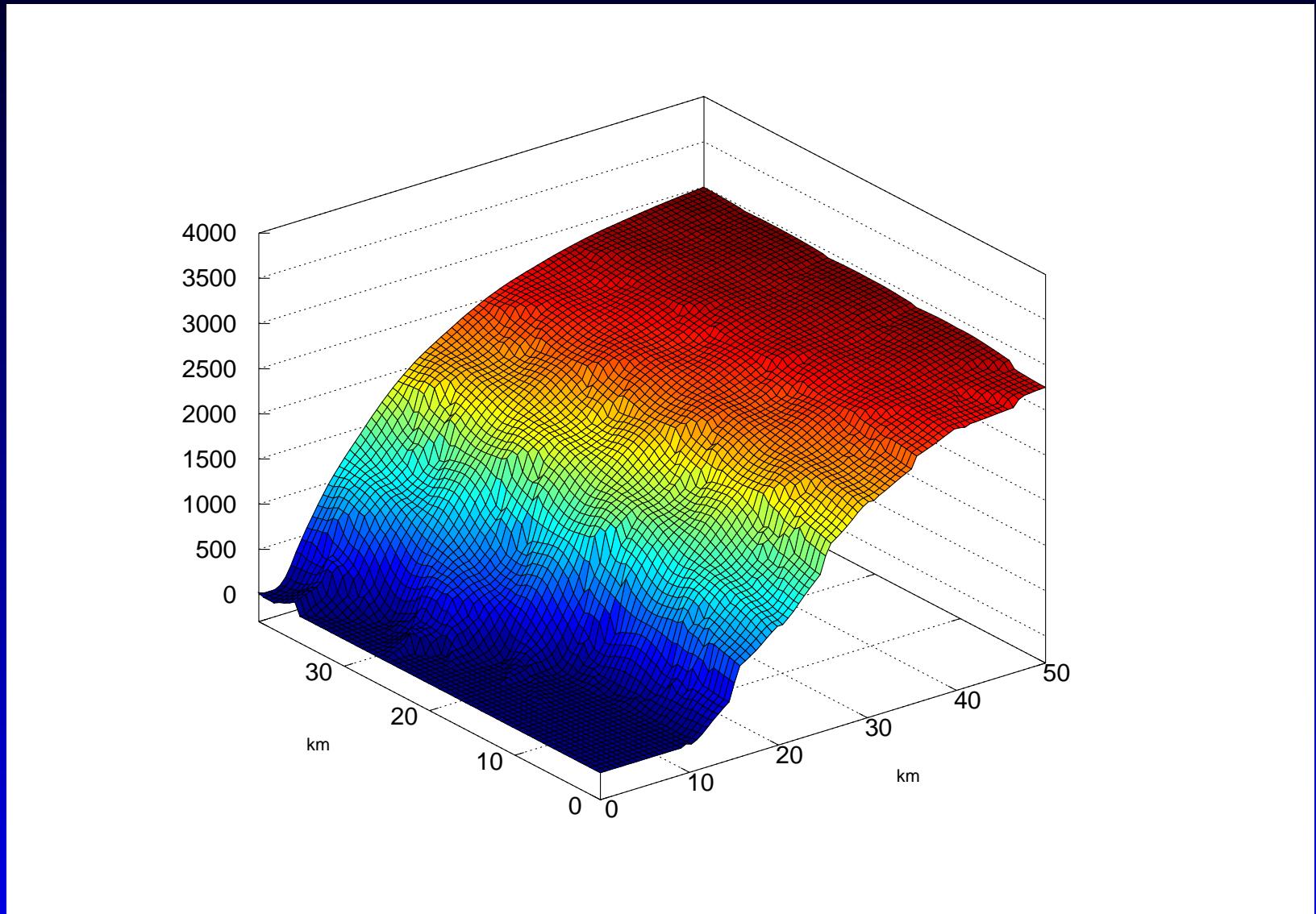
multi-beam (16 beams, 140 m across-track, 2.1 km swath)

Reconstruction of Glacier Bulge Surface – 20 km



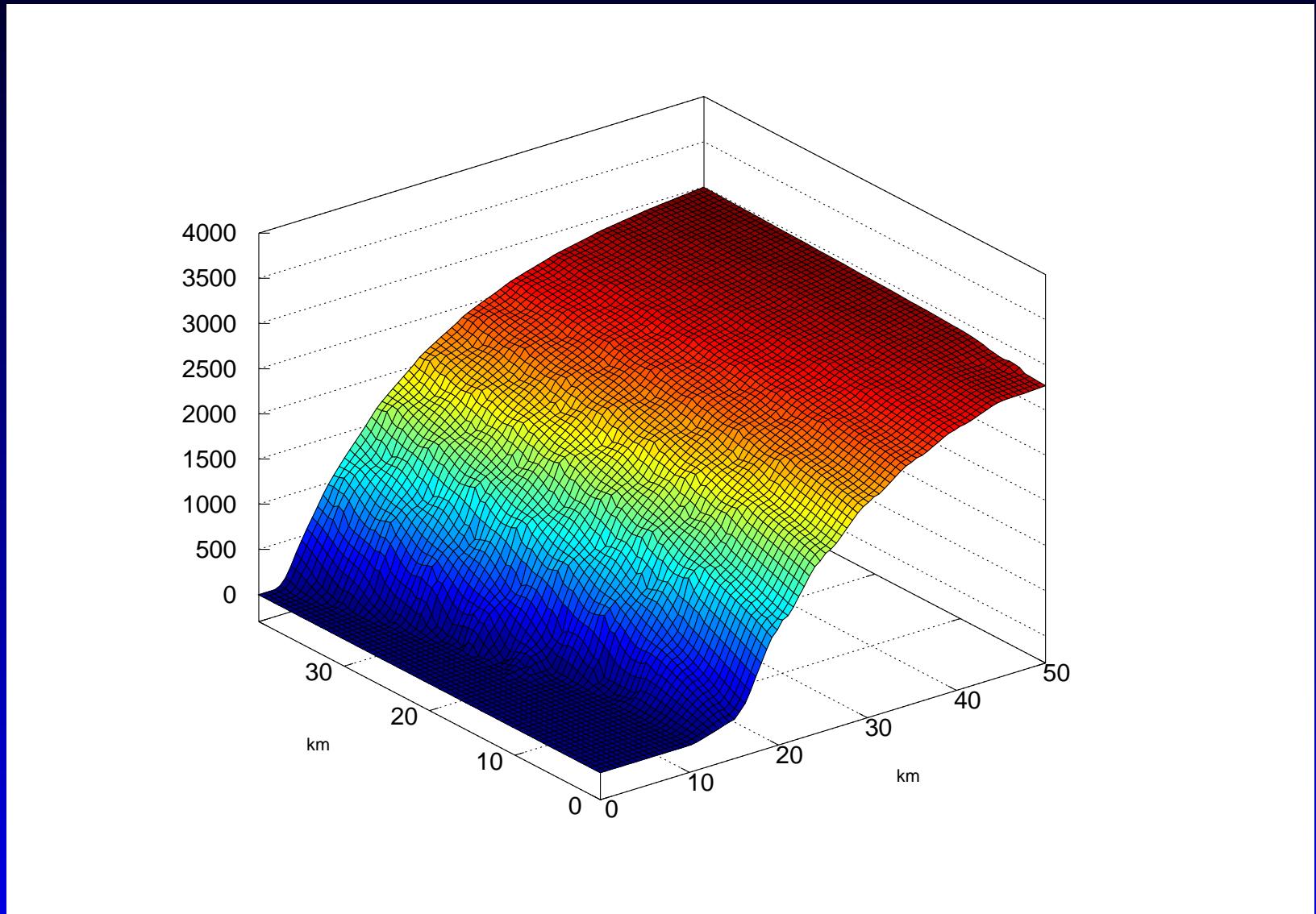
DEM from SB (GLAS) data, 20 km spaced, ordinary kriging, 200 m grid
(every 3rd plotted)

Reconstruction of Glacier Bulge Surface – 10 km



DEM from SB (GLAS) data, 10 km spaced, ordinary kriging, 200 m grid
(every 3rd plotted)

Reconstruction of Glacier Bulge Surface – 5 km

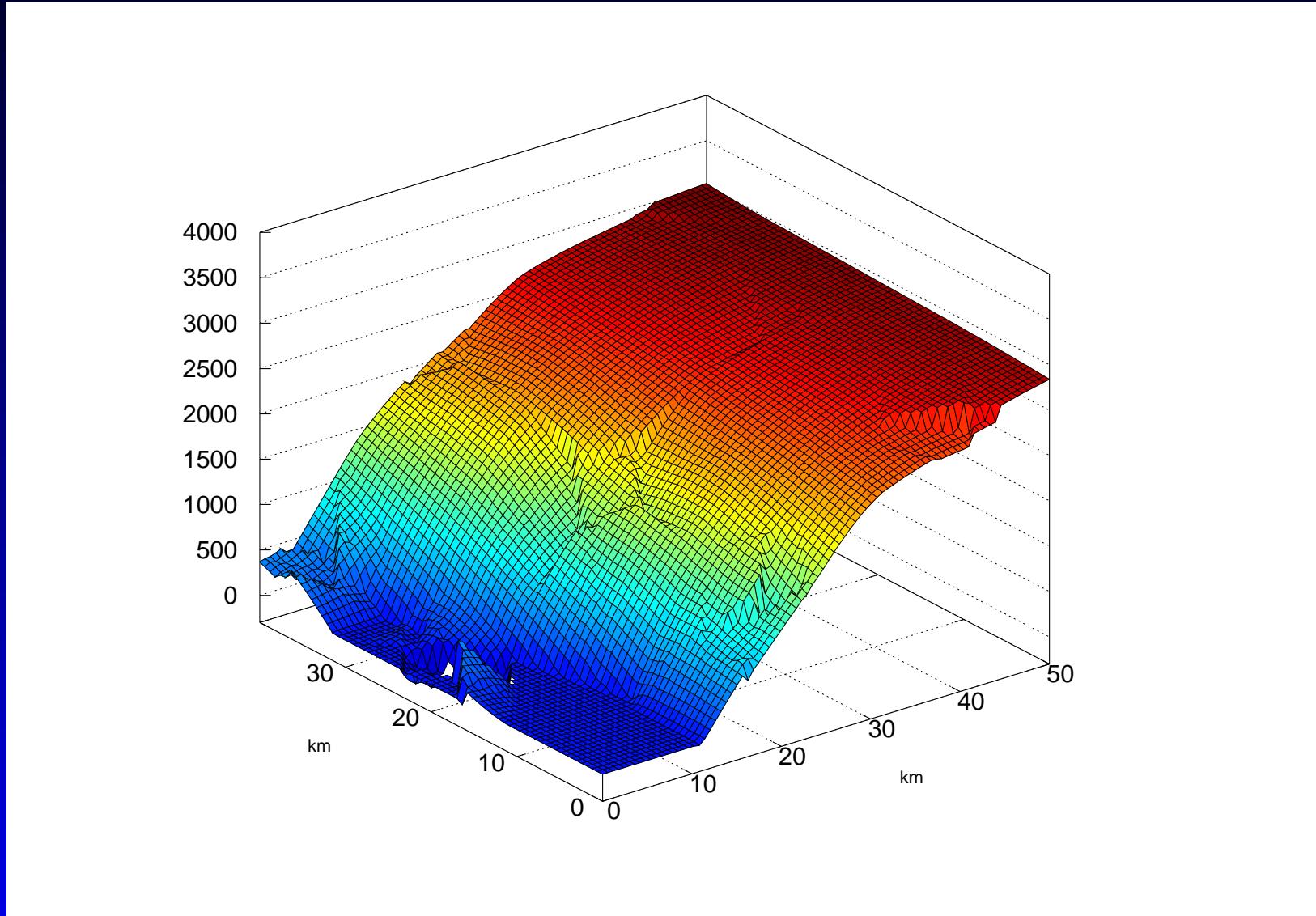


DEM from SB (GLAS) data, 5 km spaced, ordinary kriging, 200 m grid
(every 3rd plotted)

For ICESat2: Experiment Steps

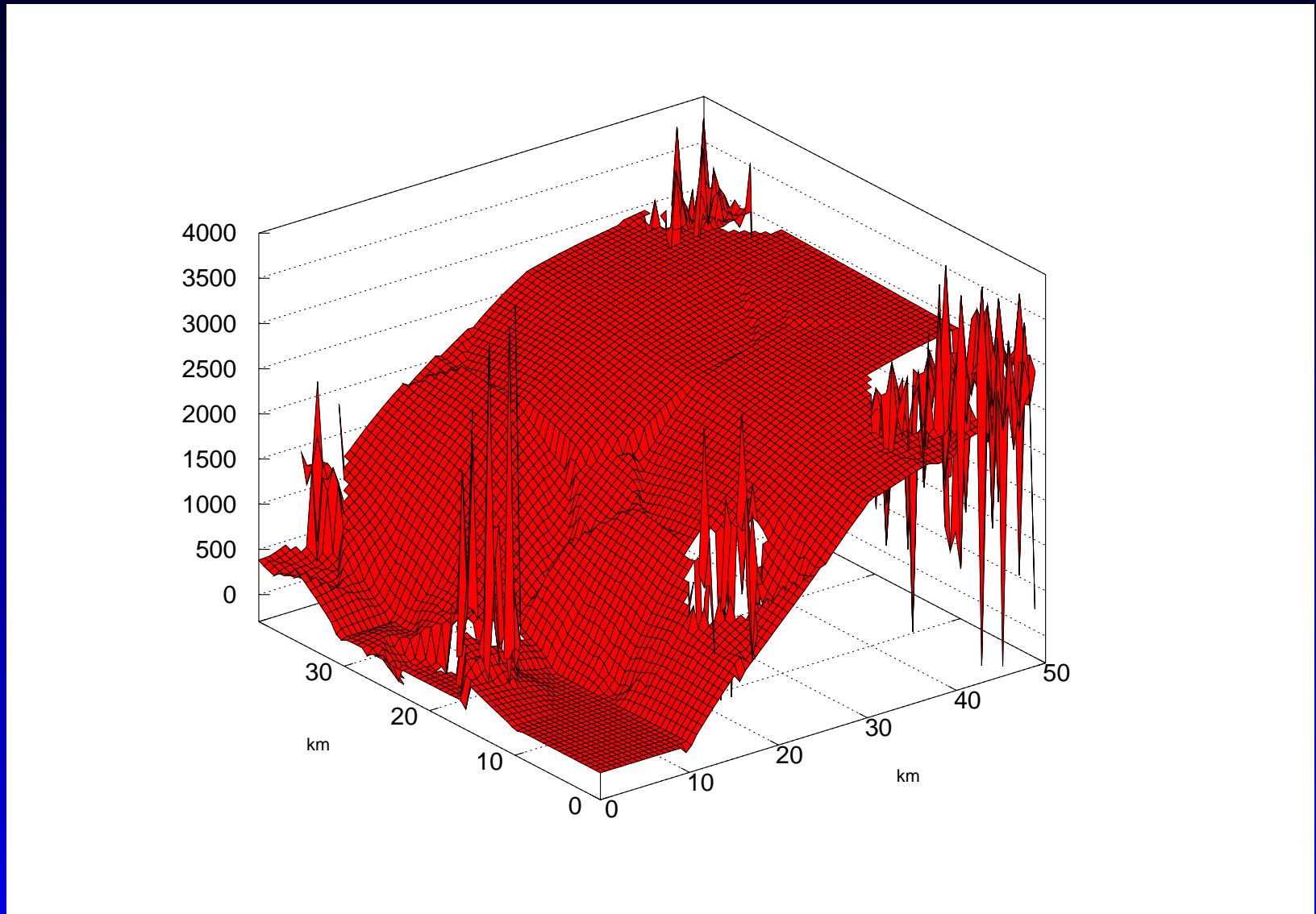
- (1) model an ice surface with non-linear and/or non-differential slope
- (2) select sample beam configurations
 - (a) single beam (GLAS type, 50kHz): 140 m along-track
 - (b) double beam: 2 beams spaced 5 km apart, 140 m along-track
 - (c) multi-beam: 16 beams, spaced 140 m across-track (swath width 2.1 km), 140 m along-track
 - (d) quad-beam: 4 beam, -70m, 70m, 3930m, 4070m, nadir at 2000m
- (3) select sample orbits
 - (a) 20 km spacing ($\approx 50^\circ$ lat, 91-d repeat cycle)
 - (b) 10 km spacing (70° lat, 91-d; or 50° lat, 183-d repeat)
- (4) reconstruct the surface, using geostatistical interpolation/extrapolation
 - (a) ordinary kriging
 - (b) advanced kriging methods

Reconstruction of Glacier Bulge Surface – 4



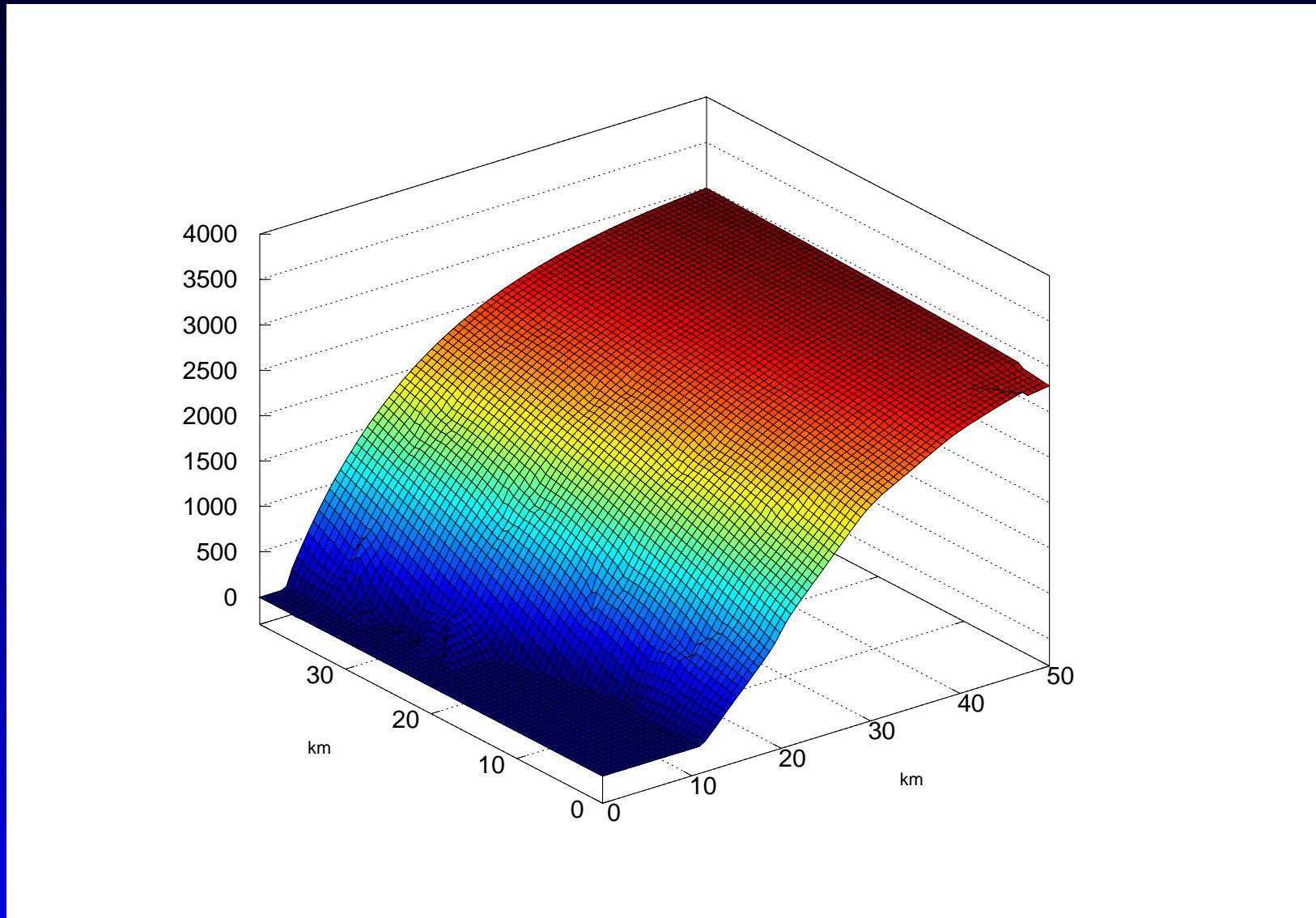
DEM from MB data, 20 km spaced, advanced kriging, 200 m grid (every 3rd plotted)

Reconstruction of Glacier Bulge Surface – 5



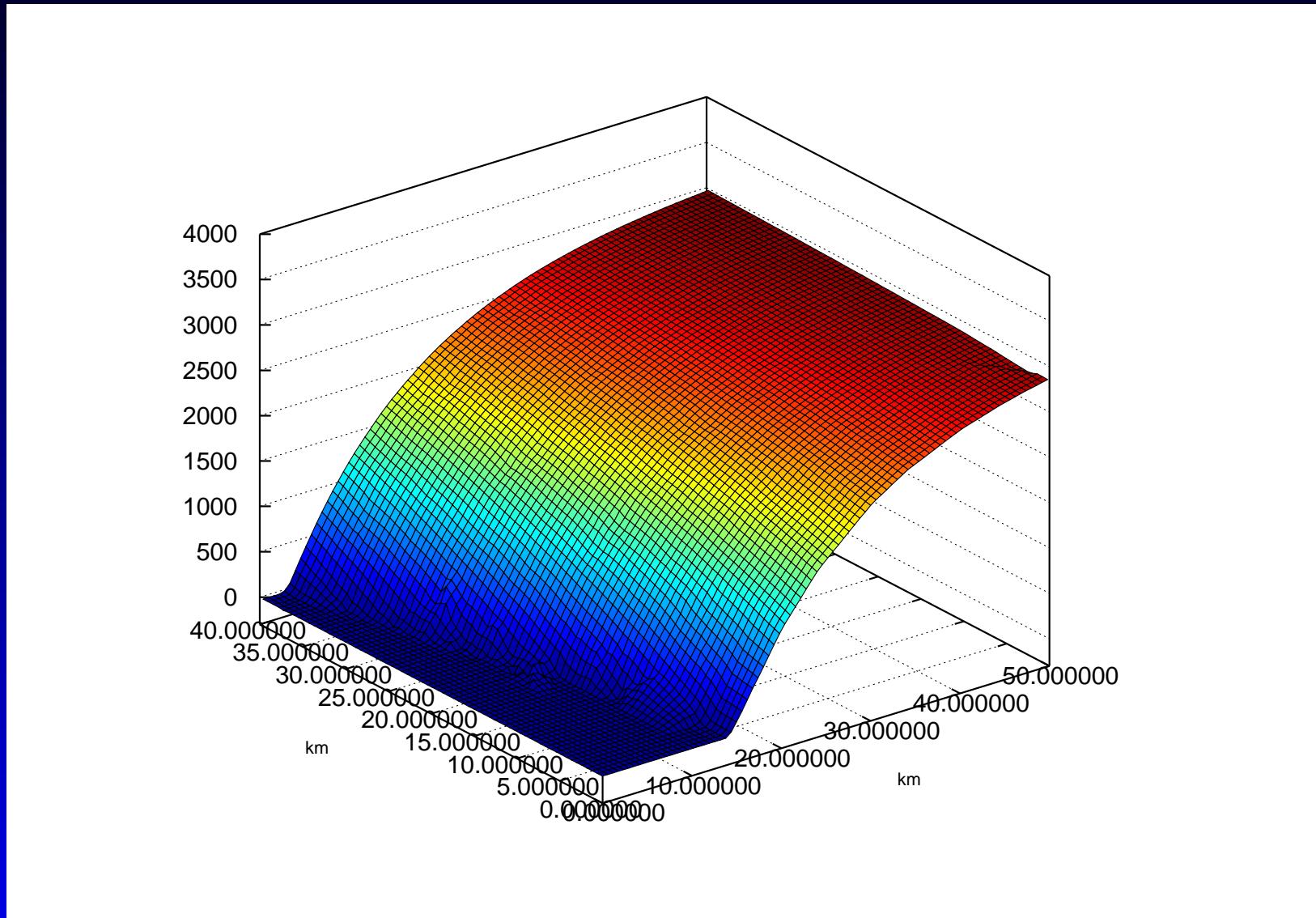
DEM from SB data, 20 km spaced, advanced kriging, 200 m grid (every 3rd plotted)

Reconstruction of Glacier Bulge Surface – 10 km, MB(16B), AK



DEM from MB data, 10 km spaced, advanced kriging, 200 m grid (every 3rd plotted)

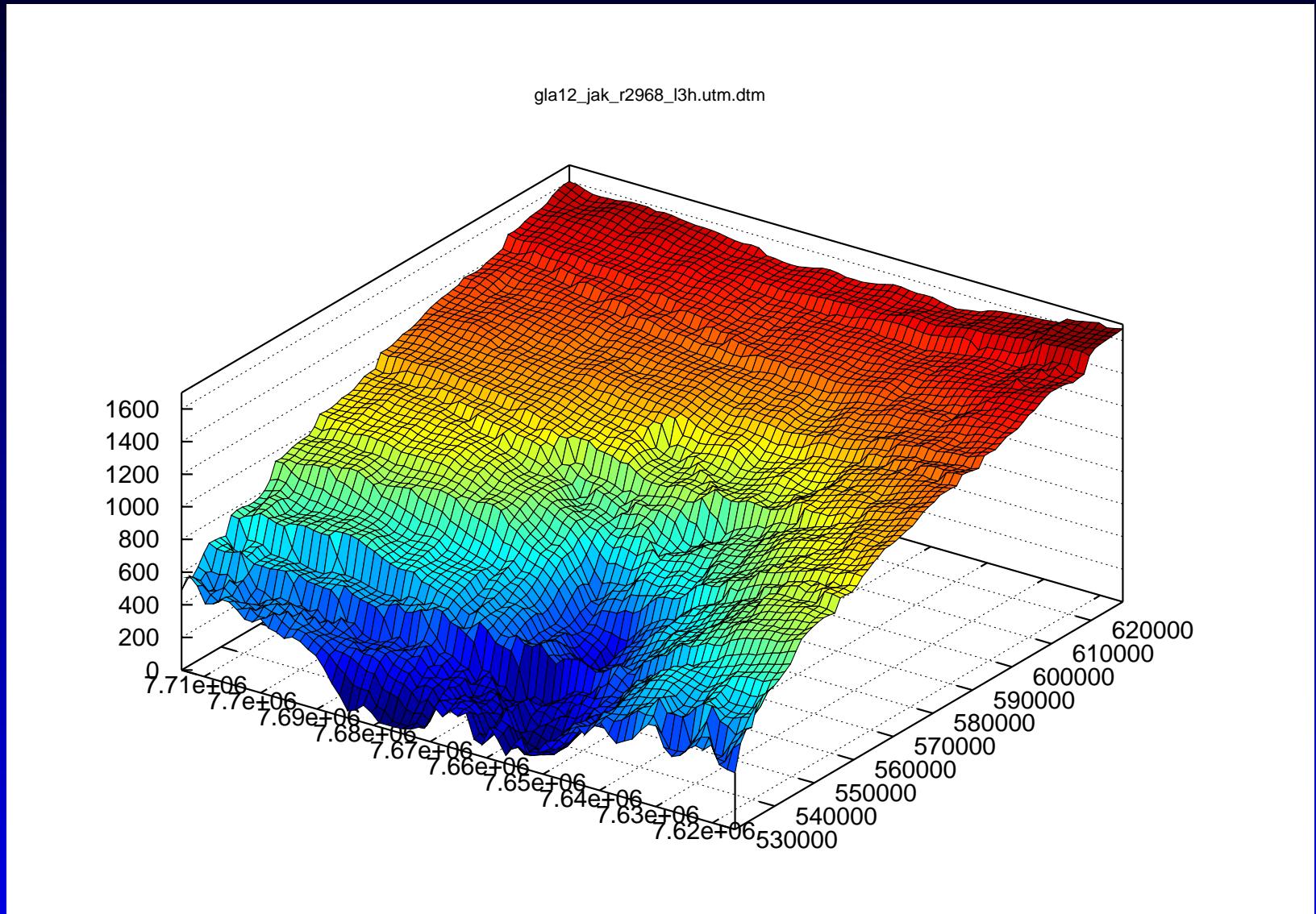
Reconstruction of Glacier Bulge Surface –10 km, 4B, AK



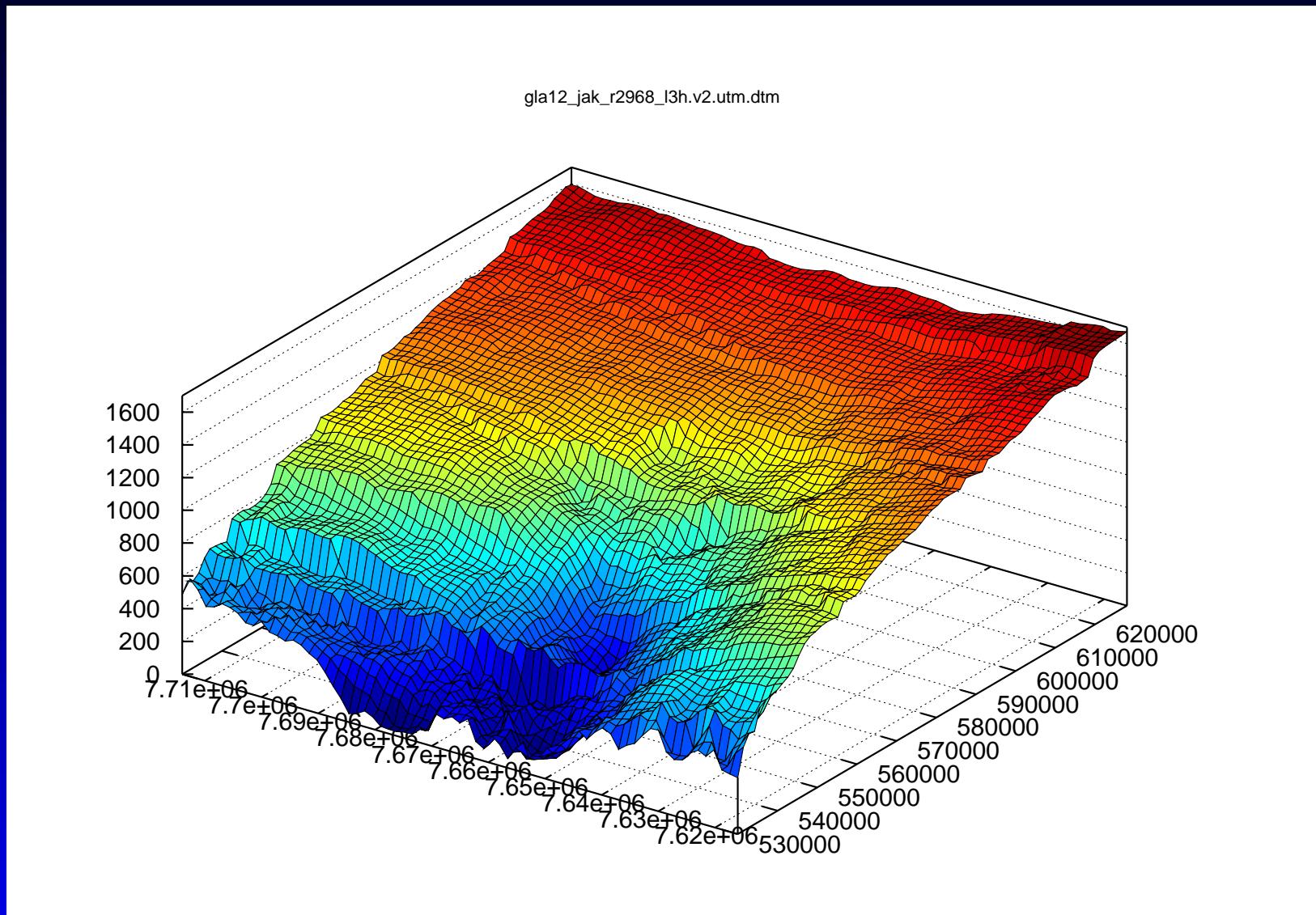
DEM from 4B data, 10 km spaced, advanced kriging, 200 m grid (every 3rd plotted)

Note 3: Track Density and Grid Density

Jakobshavn Isbrae, GLAS (L3H) - 1

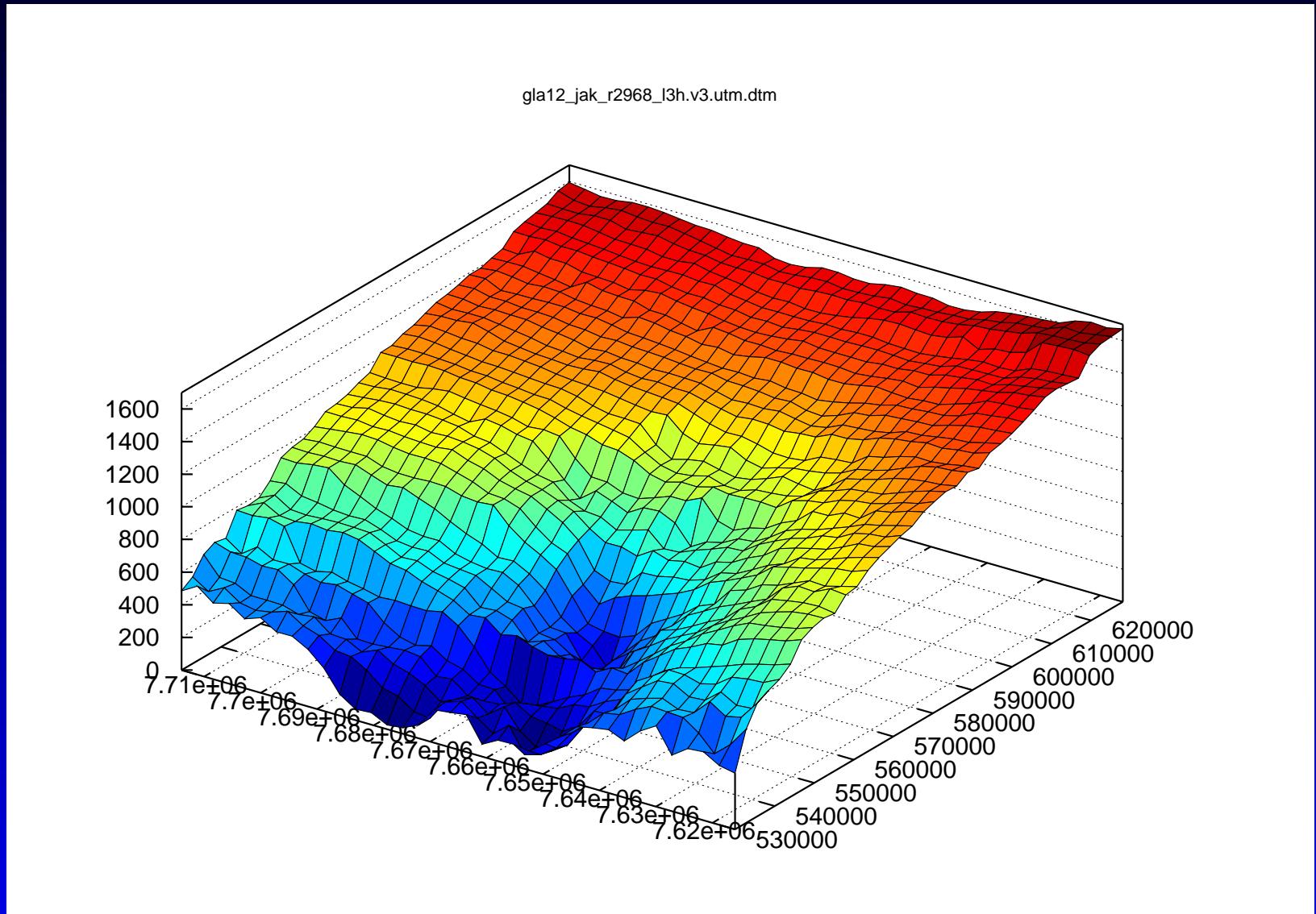


Jakobshavn Isbrae, GLAS (L3H) - 2



DEM from GLAS L3H data, 1400 m grid
OK, Gaussian Vario (1500, 2000, 6000m)

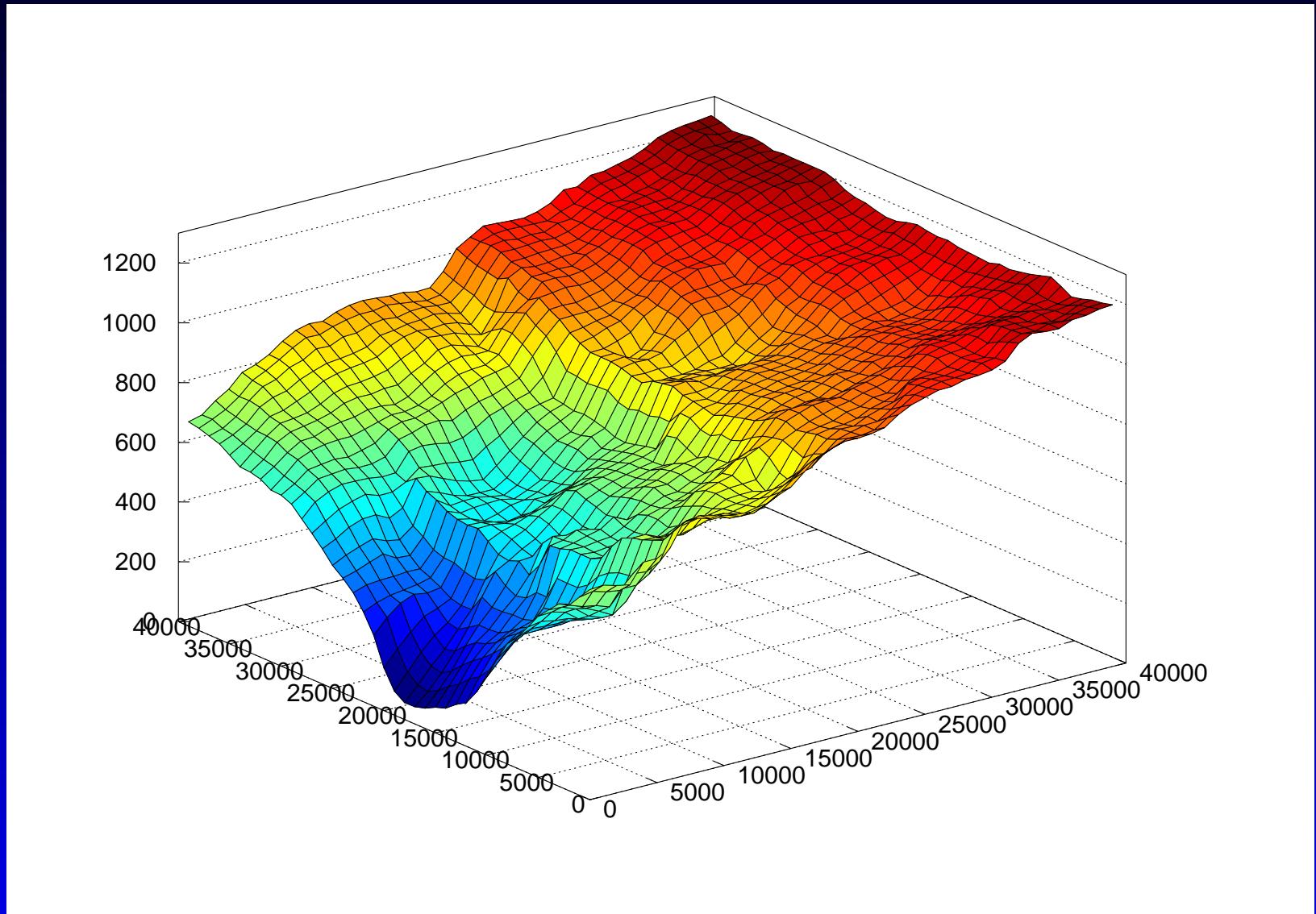
Jakobshavn Isbrae, GLAS (L3H) - 3



DEM from GLAS L3H data, 2800 m grid
OK, Gaussian Vario (1500, 2000, 6000m)

Appendix

Jakobshavn Isbrae, GLAS (L3H) - ProcSim



DEM from GLAS L3H data, 1400 m grid
Procedural Algorithm Simulation

Accuracy of Surface Reconstruction

System	Spacing	Algo	0 km	1 km	2 km	5 km	10km
1B	5 km	OK	99.71	102.06	101.59	99.78	
1B	10 km	OK	96.81	133.93	156.35	117.59	
1B	20 km	OK	96.13	132.58	148.53	158.38	194.89

Table 1: Error in meters (difference bt original surface and reconstructed surface, dependent on distance of grid node from nadir position). Error values are calculated for a region where surface slope is approximately 2° and nonlinear.

Accuracy of Surface Reconstruction

System	Spacing	Algo	0 km	1 km	2 km	5 km	10km
1B	10 km	OK	96.81	133.93	156.35	117.59	
2B	10 km	OK	99.71	102.06	101.59	99.78	
4B	10 km	OK	0.34	5.66	8.46	4.62	
4B	10 km	AK	0.57	0.64	0.67	0.53	
16B	10 km	OK	-0.60	1.18	29.08	11.13	
16B	10 km	AK	0.31	0.33	2.46	9.47	
1B	20 km	OK	96.13	132.58	148.53	158.38	194.89
2B	20 km	OK	-2.24	18.96	14.77	0.31	41.87
4B	20 km	AK	1.05	3.34	4.86	6.96	40.82
16B	20 km	OK	-0.602	0.93	27.72	46.19	73.36
16B	20 km	AK	0.31	0.48	7.78	30.67	52.79

Table 2: Error in meters (difference bt original surface and reconstructed surface, dependent on distance of grid node from nadir position). Error values are calculated for a region where surface slope is approximately 2° and nonlinear.